MARSHALL

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

MAR 1 1974

TO: KSI/Scientific & Technical Information Division
Attn: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,788,163

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) : ~

NASA Patent Case No. : MFS-21,481-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

YES ☐ NO ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "...with respect to an invention of ..."

Bonnie L. Woerner
Enclosure

United States Patent [19]

Gause et al.

[11] **3,788,163**

[45] **Jan. 29, 1974**

[54] **MANUAL ACTUATOR**

[75] Inventors: **Raymond L. Gause,** Huntsville; **C. G. Glenn,** Arab, both of Ala.

[73] Assignee: **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration,** Washington, D.C.

[22] Filed: **June 27, 1972**

[21] Appl. No.: **266,771**

[52] **U.S. Cl.** ..... **74/594.6,** 74/594.7, 128/25 R, 272/73, 272/80

[51] **Int. Cl.** **G05g 1/16**

[58] **Field of Search** ..... 74/594.6, 594.4, 594.7; 272/58, 73, 79 R, 80; 128/25 R

[56] **References Cited**

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2,964,973	12/1960	Bergfors	74/594.6
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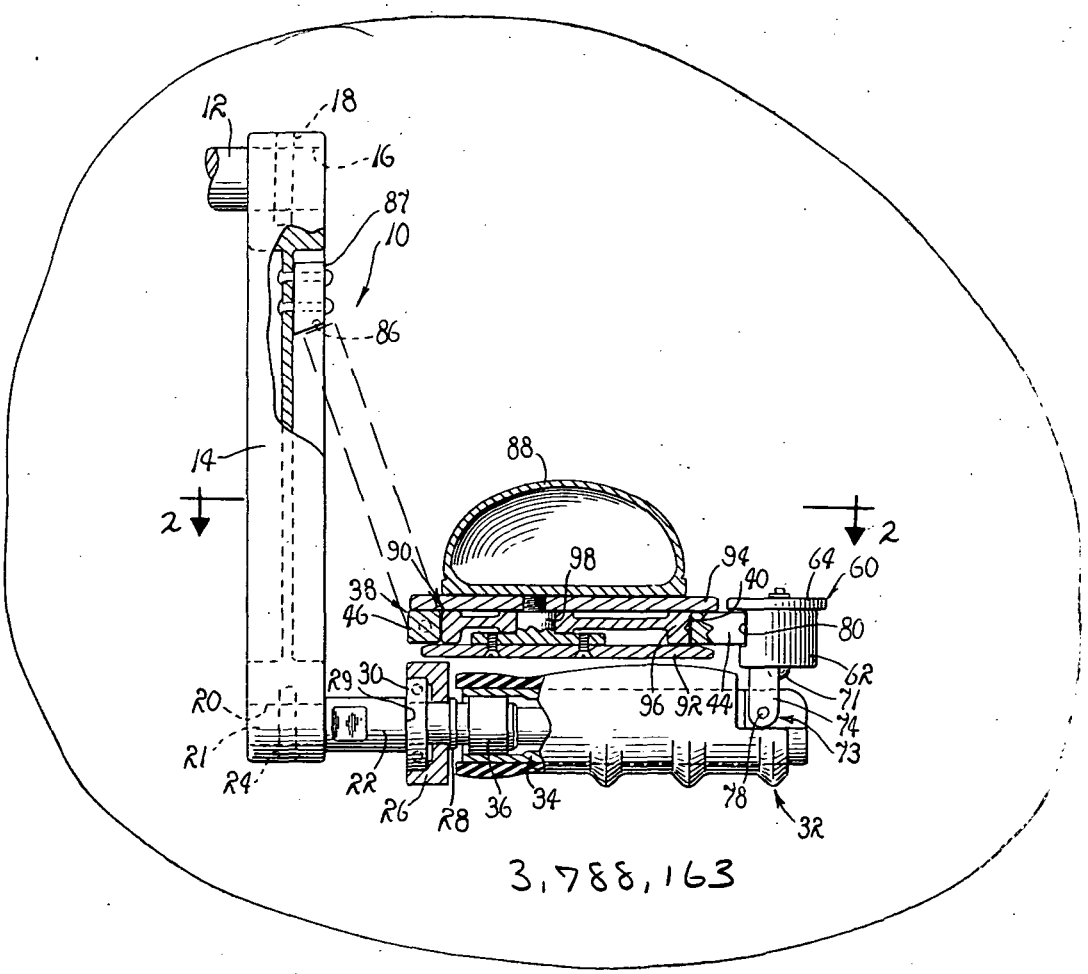
Primary Examiner—Manuel A. Antonakas
Assistant Examiner—F. D. Shoemaker
Attorney, Agent, or Firm—L. D. Wofford, Jr. et al.

[57] **ABSTRACT**

An actuator for an exercising machine employable by a crewman aboard a manned spacecraft. The actuator is characterized by a force delivery arm projected from a rotary input shaft of an exercising machine and having a force input handle extended orthogonally from its distal end. The handle includes a hand-grip configured to be received within the palm of the crewman's hand and a grid pivotally supported for angular displacement between a first position, wherein the grid is disposed in an overlying juxtaposition with the hand-grip, and a second position, angularly displaced from the first position, for affording access to the hand-grip, and a latching mechanism fixed to the sole of a shoe worn by the crewman for latching the shoe to the grid when the grid is in the first position.

4 Claims, 6 Drawing Figures



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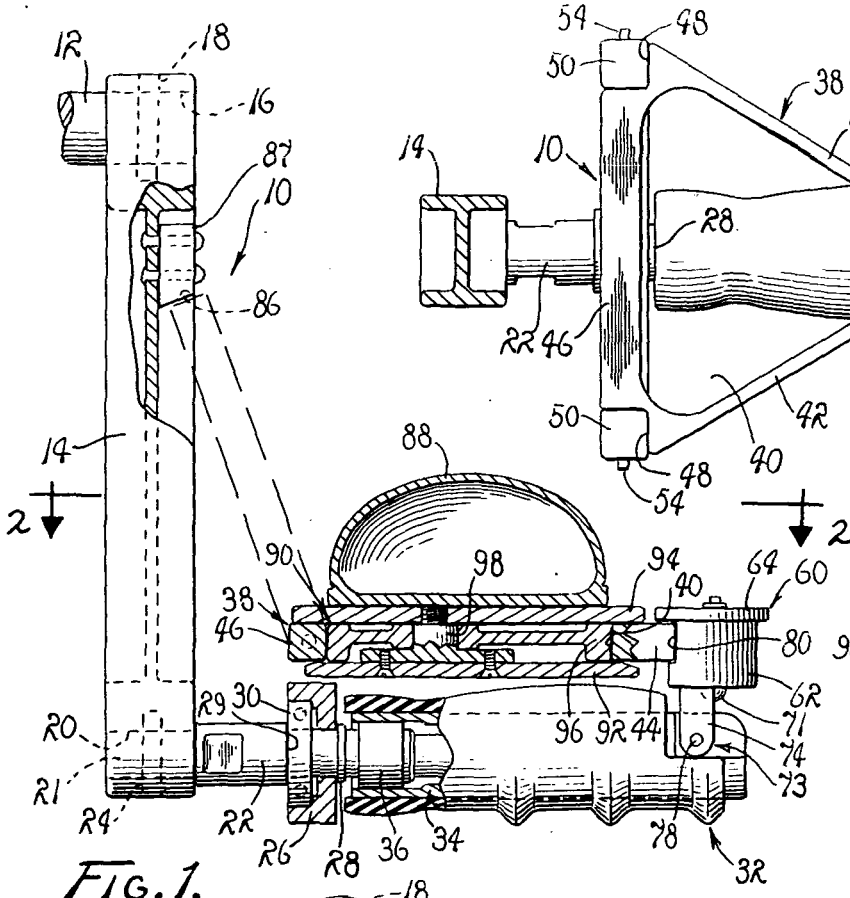

FIG. 1.

FIG. 2.

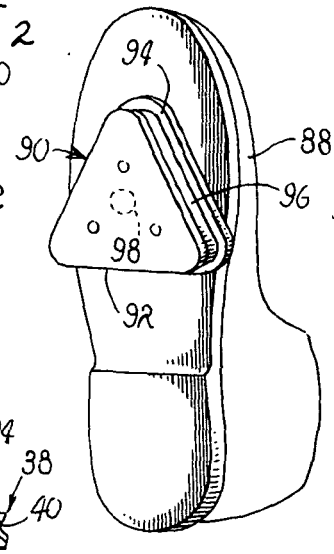

FIG. 5.

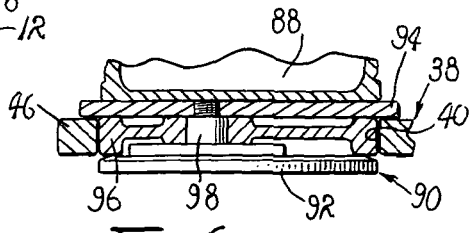

FIG. 6.

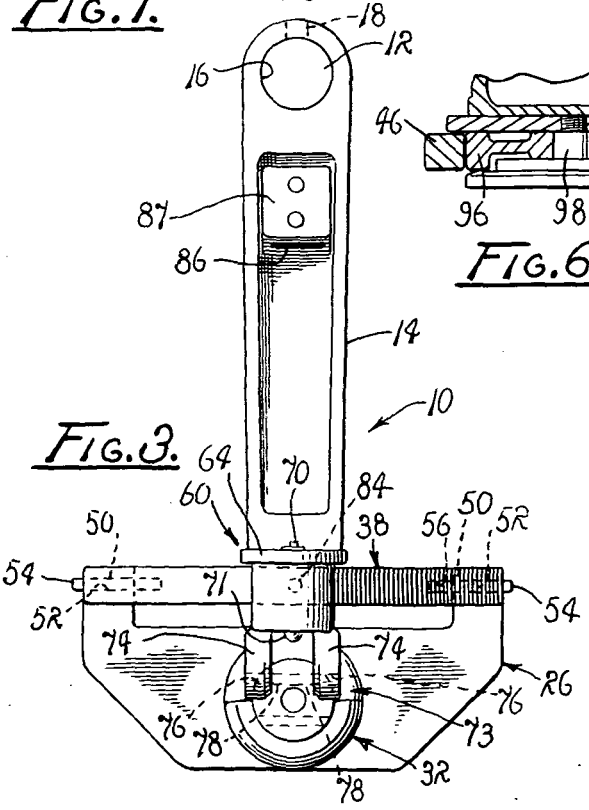

FIG. 3.

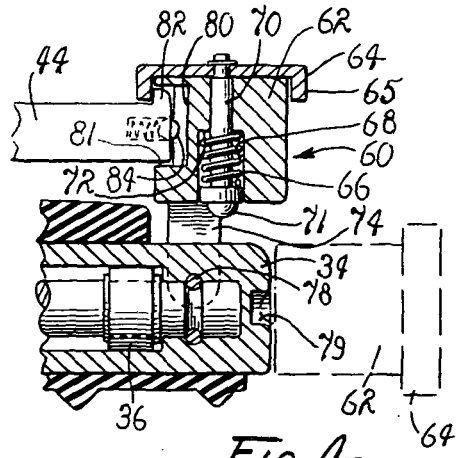

FIG. 4.

MANUAL ACTUATOR

ORIGIN OF INVENTION

The invention described herein was made by employees of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties or therefor.

BACKGROUND OF THE INVENTION

The invention relates to input devices for exercising machines, ergometers and the like, and more particularly to a manual actuator selectively configured for use by a crewman aboard spacecraft selectively employing his hand or his foot.

The prior art is replete with exercising machines and similar mechanisms having manually operable input devices utilized in exercising the muscles of the human body and its limbs. Such machines are typified by a machine disclosed in the United States Letters Patent, No. 2,783,044, which issued Feb. 26, 1957 to D. G. Sbarra. The prior art devices, however, fail to fully satisfy the existing needs of crewmen confined aboard operative spacecraft, particularly those engaged in conducting missions of extended durations.

As can readily be appreciated by those familiar with spacecraft operations, a zero gravity environment, accompanied by a lack of suitable facilities for accommodating sufficient muscular activity, tends to have debilitating effects on crewmen manning spacecraft. Consequently, it is highly desirable to provide aboard spacecraft suitable mechanisms for affording the crewmen opposrtunities to exercise the muscles located within their bodies and limbs. Of course, in view of prevailing bulk and weight requirements, any mechanism provided for this purpose aboard a spacecraft preferably is of a compact, lightweight construction, simple to operate and practical to employ.

Therefore, it is the purpose of the instant invention to provide an actuator for a manually operable exercising machine which is practical, compact, of lightweight and durable construction, and one which can readily be converted for efficient and safe operation when using either a crewman's hand or his foot.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the instant invention to provide an improved actuator for use with manually operable exercising machines.

It is another object to provide an improved actuator for use by crewmen in exercising the muscles within their bodies and limbs while confined aboard spacecraft.

It is another object to provide an improved actuator for exercising machines, adapted to be manually driven employing either a hand or a foot.

It is another object to provide an actuator for a manually operable exercising machine which includes a force delivery arm, coupled with a rotary input of an exercising machine, and a hand-grip configured to be received within the palm of an operator's hand, and a latching mechanism for coupling a foot of an operator thereto.

These and other objects and advantages are achieved through the use of a force delivery arm coupled at its base with a rotary input shaft and having at its distal end a normally related hand-grip configured to be received within the palm of a crewman's hand, and a restraining mechanism for releasably coupling the crewman's foot with the handle, as will become more readily apparent by reference to the following description and claims in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned, fragmented view of an actuator, which embodies the principles of the instant invention illustrating a handle coupled with a force input arm and a restraining mechanism through which a foot of a crewman is coupled with the actuator.

FIG. 2 is a partially sectioned top plan view taken generally along line 2—2 of FIG. 1, the crewman shoe and attached coupling mechanism being omitted for clarity.

FIG. 3 is a partial side elevation of the actuator.

FIG. 4 is a fragmented view, partially in phantom, illustrating locking means employed in supporting the restraining mechanism in an operative position relative to the handle.

FIG. 5 is a perspective view of the restraining mechanism through which a foot of the crewman operatively is coupled with the handle.

FIG. 6 is a cross-sectional view of the plates shown in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a partially sectioned view of an actuator, generally designated **10**, which embodies the principles of the instant invention.

While not shown, it is to be understood that the actuator **10** is coupled with an exercising machine, an ergometer or any similar device, through a rotary input shaft **12**. As a practical matter, the base of a force delivery arm **14** which includes a bore **16**, receives therein the shaft **12** and is affixed thereto by a suitable locking pin **18**. Since the particular manner in which the force delivery arm **14** is coupled with the shaft **12** is deemed a matter of convenience only, a detailed description of the coupling is omitted in the interest of brevity. However, it is to be understood that the base of the arm **14** is rigidly fixed to the input shaft **12** so that, in operation, the distal end thereof is caused to describe a circle concentric with the longitudinal axis of symmetry of the shaft **12**.

The distal end of the arm **14** also includes a bore, designated **20**. The longitudinal axis of the bore **20** is arranged in parallelism with the longitudinal axis of the bore **16** and is normally related to the longitudinal axis of symmetry of the arm **14**. Within the bore **20** there is seated, in fixed relationship, the base **21** of a stub shaft **22**. While the stub shaft **22** can be screw-threadedly received within the bore **20**, a locking pin **24** serves quite satisfactorily for fixedly coupling the stub shaft **22** with the arm **14**.

Supported for rotation about the stub shaft **22** there is a bracket **26**. This bracket is maintained in an operative position by a suitable lock-ring **28**, seated in an appropriately formed groove, and an annular thrust bearing **29**. A race **30** is seated in the bracket **26** and sup-

ports the bracket for rotation about the longitudinal axis of the stub shaft 22.

The stub shaft 22 supports a concentrically related hand-grip, generally designated 32. As a practical matter, the hand-grip 32 includes a sleeve 34 concentrically related to the stub shaft and supported by a pair of coaxially spaced bearings 36 which are, in turn, concentrically related to the opposite end portions of the sleeve 34. About the sleeve 34 there is received a tubular portion of the hand-grip 32 formed of a suitable material and having an external surface particularly configured to be received within the hand of a crewman for facilitating a grasping of the handle.

Also supported by the bracket 26 is a grid 38 having formed therein an opening 40 of a triangular configuration. As a practical matter, the grid 38 includes a pair of legs 42 converging toward an apex 44 and extending from a common base 46. The base 46, as best shown in FIG. 2, is provided with a pair of coaxially aligned reliefs 48 which serve to receive therein a pair of laterally spaced, coplanar legs 50. These legs project from opposite ends of the bracket 26 and terminate in a coplanar relation with one surface of the base 46.

The distal end portions of the legs 50 are provided with a pair of coaxially aligned bores 52 which receive therein pivot pins 54. These pins extend into a pair of blind bores 56 coaxially aligned within the opposite ends of the base 46 of the grid 38. Accordingly, it can be appreciated that the grid 38 is supported for pivotal rotation from a first position, as illustrated in FIG. 1 to a second position angularly related to the first position, as indicated in phantom in FIG. 1.

In order to maintain the grid 38 in the first position, as illustrated in FIG. 1, there is provided a latching mechanism generally designated 60. This mechanism serves to engage the apex portion 44 of the grid 38 and retains the grid against pivotal displacement about the pins 54.

The latching mechanism 60 includes an elongated body 62 having extended across one end face thereof a normally related latching member 64 of a cap-like configuration. The latching member 64 is of a disk-shaped configuration and includes an annular lip 65. This lip serves to engage an adjacent surface of the apex portion 44 of the grid 38 for retaining the grid against pivotal displacement.

In practice, the latching member 64 is supported for axial displacement relative to the body 62 and is spring-biased toward the body by a compression spring 66 of a helical configuration. The spring 66 is seated in a concentric bore 68 which extends through the body 62. The spring 66, in turn, concentrically receives a pin 70 is maintained under compression between the head 71, and the annular shoulder 72 formed within the bore 68. The pin 70 extends through the bore 68 and is affixed to the central portion of the latching member 64 by a suitable lock-ring, also not designated. It should therefore readily be apparent that axial displacement of the latching member 64 away from the body 62 is opposed by the spring 66.

In practice, the body 62 is pivotally supported for rotation about the distal end of the hand-grip 32 by a suitable clevis coupling, generally designated 73. The clevis coupling 73 includes a pair of arms 74 having formed therein a pair of coaxially aligned, pin-receiving bores 76. The bores 76 serve to receive a pin 78 which extends through the distal end of the sleeve 34, FIG. 4.

It will, therefore, be appreciated that the latching member 64 is supported for pivotal displacement from a first position wherein the body 62 is coaxially aligned with the hand-grip 32, to a second position wherein the body 62 is orthogonally related with respect to the longitudinal axis of symmetry of the hand-grip. At the second position, the body 62 is in juxtaposition with the apex portion 44 of the grid 38 with the annular lip 65 extended into engaging relationship with the adjacent surface of the grid 38.

The head 71 of the pin 70 also functions as a locking protuberance and is received within a detent 79 formed in the adjacent end surface of the sleeve 34, when the body 62 is positioned in its first position. Thus the latching mechanism 60 is retained in coaxial alignment with the hand-grip 32 as a consequence of the seating of the head 71 within the detent 79.

As a practical matter, the body 62 also is provided with a relief 80, having a shoulder 81, within which there is received the adjacent portion of the apex portion 44 of the grid 38. The shoulder lends additional support to the grid 38 so that the grid is supported against pivotal displacement when it is received within the releif 80. Furthermore, a lip 82 is extended from the apex portion 44 into locking engagement with the lip 65 of the latching member 64 in order to assure that a positive coupling between the latching mechanism 60 and the grid is achieved when the grid and the latching mechanism are brought into a coupling relationship.

As best shown in FIG. 4, the apex portion 44 of the grid 38 also is provided with a spring-loaded ball 84 configured to be received within a detent 86 in a block 87 provided along the surface of the arm 14. The block is positioned adjacent to the apex portion 44 of the grid 38 when the grid is in its second position, angularly displaced from it first position. Thus, the ball 84 and the detent 86 cooperatively serve as a coupling means for supporting the grid 38 against pivotal displacement toward the hand-grip 32 in order to support the grid in a stowed configuration when the actuator 10 is operated employing a hand.

It is important here to note that the grid 38 is selectively coupled with an operator's shoe 88 through a stack of latching plates, generally designated 90. As a practical matter, the stack of plates 90 includes a pair of coupling plates 92 and 94 between which is sandwiched an aligning plate 96, each being of a triangular configuration. The plates 92 and 94 are maintained in coincidence through a concentric shaft 98 extended therebetween, while the aligning plate 96 is free to rotate relative to the shaft 98. The plate 94 is fixed to the sole of the shoe 88, while the aligning plate 96 frictionally engages the shaft 98 in order that rotation of the aligning plate relative to the shaft 98 is, for practical reasons, inhibited by frictional forces.

It is to be understood that the plates 92 and 96 are configured to be received within the opening 40 of the grid 38, while the plate 94 is dimensioned to engage the adjacent surface of the grid 38, when the grid is supported at its first position by the latching mechanism 60. However, the legs 42 are spaced from the adjacent surface of the hand-grip 32 a distance such that the plate 92 is afforded angular displacement for repositioning the adjacent apexes of the triangular plate 92 into misalignment with the opening 40 and into locking engagement with the adjacent surfaces of the legs 42 and base 46 of the grid 38, FIG. 1.

The thickness of the legs **42** and the base **46** is such that the aligning plate **96** is supported against rotation thereby as the plates **92** and **96** are rotated with respect to the grid. Since the plates **92** and **94** are maintained in a fixed mutual relationship, through the shaft **98**, it is to be understood that the shaft is supported by the shoe **88** of the crewman.

It will, of course, be appreciated that the plate **94** is affixed to the sole of the shoe **88** in any appropriate fashion. Therefore, a detailed description of the mounting of the plate **94** is omitted in the interest of brevity, particularly since the manner in which the stack of plates **90** is coupled with the shoe can be varied as found desirable.

It should, therefore, readily be apparent that the stack of plates **90** serves as a coupling means for uniting the shoe **88** with the grid **38** and that such a union can readily be effected simply by inserting the plates **92** and **96**, of the stack of plates **90**, into the opening **40** and thereafter angularly displacing the shoe **88** about an axis concentric with the longitudinal axis of the shaft **98**. A reversing displacement of the foot, of course, serves to effect disengagement of the shoe from the grid.

OPERATION

It is believed that in view of the foregoing description, the operation of the device will be readily understood and it will be briefly reviewed at this point.

It is to be understood that the actuator **10** is particularly suited for use with exercising machines, ergometers and the like particularly suited to be mounted aboard spacecraft and employed by the feet or the hands, depending upon which operation is preferred in exercising a crewman. Furthermore, it is intended that the actuator **10** serve as an input to the exercising machine, however, in the event the machine is a motorized machine it is entirely feasible to employ the actuator in a reverse mode so that the actuator **10**, in effect, becomes the output side for the machine.

In those instances wherein the actuator **10** is to be employed utilizing the hands of a crewman grasping the hand-grip **32**, the grid **38** is pivotally displaced to its second position wherein the ball **84** is seated within the detent **86** for supporting the grid **38** in angular displacement relative to the hand-grip **32**. With the grid **38** thus supported, the crewman merely grasps the hand-grip **32** and applies a rotating force about the longitudinal axis of the shaft **12** for delivering a rotating force to the shaft **12**.

In instances wherein it is desirable to couple a crewman's foot with the actuator **10**, the grid **38** is pivotally displaced into juxtaposition with the hand-grip **32** and the latching member **64** pivotally displaced into juxtaposition with the apex portion **44** of the grid. In this position, the adjacent apex portion **44** of the grid **38** is received within the relief **80** of the body **62** and the lip **65** is caused to engage the lip **82**. Thus, the grid is positively restrained against rotation about the pins **54**. The crewman now inserts the plates **92** and **96** of the stack of plates **90** within the opening **40**, within the grid **38**, and imparts rotation thereto for causing the plates **92** and **94** to rotate into a misaligned relation with the opening **40** for sandwiching adjacent portions of the legs **42** and the base **46** between their apex portions. Thus, the stack of plates **90** is positively united with the grid **38**. As a practical matter, rotation of approximately 12° is sufficient to establish the desired union between the stack of plates and the grid.

Of course, disassociation of the stack of plates from the grid **38** can be readily achieved simply by rotating the stack in an opposite direction for again aligning the plates with the opening **40** and thereafter extracting the plates therefrom.

In view of the foregoing, it should readily be apparent that the device of the instant invention provides a practical solution to the perplexing problem of providing a suitable mechanism for accommodating an exercise of crewmen aboard spacecraft during missions of extended duration.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the illustrative details disclosed.

We claim:

1. An actuator for a manually operable exercising machine adapted to be employed by a crewman confined aboard an operative spacecraft comprising:

A. a force delivery arm;

B. means for coupling the base of the force delivery arm with an exercising machine;

C. a force input handle including a shaft normally extended from the distal end of said arm and a hand-grip supported by said shaft configured to be received within the palm of a crewman's hand;

D. said shaft being concentrically related to said hand-grip;

E. bearing means supporting said hand-grip for rotation relative to said shaft;

F. a support bracket rotatably coupled to said shaft;

G. grid means pivotally coupled with said bracket, including means defining therein an opening of a preselected configuration, and supported for angular displacement between a first position adjacent to said hand-grip, and a second position angularly displaced from said first position;

H. latching means for restraining said grid means against angular displacement between said first and second positions;

I. locking means receivable in said opening for releasably uniting said grid means with a foot of the crewman.

2. The actuator of claim **1** wherein said latching means includes:

A. a spring-loaded projection supported for pivotal displacement from coaxial alignment with said shaft into an overlying relationship with said grid means when the grid means is in said first position; and

B. a spring-loaded protuberance projected from said grid means, and means defining a detent for receiving said spring-loaded protuberance when said grid is in said second position.

3. The actuator of claim **1** wherein the locking means includes a plurality of superimposed plates supported for mutual rotation, selected plates being configured to be received within said opening, and means for coupling said plates with a shoe worn upon the foot of the crewman.

4. The actuator of claim **2** wherein said opening and said plates are of a triangular configuration.

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